

A Survey of Software Project Management Tool Analysis

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Abstract—Paper provides in depth review of software project management tool and literature, its benefits and drawbacks. A lot of work has been done on software project management tool in order to improve estimation accuracy. None of them gives 100% accuracy but proper use of them makes estimation process smoother and easier. Organizations should automate estimation procedures, customize available tools and calibrate estimation approaches as per their requirements. Software estimation has always been an active research area. Accurate software estimation is desirable in any software project, not only to properly schedule budget, resources, time and cost and avoid overrun but also to reasonably estimate as software organizations with better estimates and planning will be able to get the projects in bidding.

1. INTRODUCTION

Software engineering is the discipline which paves the roadmap for development of software within given schedule and effort and with the desired quality. The process begins with estimating the size, effort and time required for the development of the software and ends with the product and other work products built in different phases of development. The tools available for automating some of the activities are great help in the whole development process. However these tools isolate the process of estimation, planning & tracking and calibration. Various software project management tools are based on estimation, planning & tracking and calibrations. The problems being faced in the software developments are cost overrun, schedule overrun and quality degradation.

2. BACKGROUND

Methodologies are used in software project management tools for estimation of project

Estimation methodologies:[5]

- i. Analogy method
- ii. top down method
- iii. Bottom up method

i. Analogy method

In analogy approach the project to be estimated is compared with the already completed projects of that type if exists. The historical data of previously completed projects helps in the estimation. However it works only when previous data is available. Needs systematically maintained database.

ii. Top down method

Top down approach requires less functional and non-functional requirements and is concerned with the overall characteristics of the system to be developed. This estimation is quite abstract at the start and accuracy improves step by step. It can underestimate the cost of solving difficult low-level technical components. However top down approach takes into account integration, configuration management and documentation costs.

iii. Bottom up method

This method does estimation of each and every individual component and combines all components to give the overall, complete estimation of project. This approach can be an accurate method if the system has been designed in detail. However bottom up method can underestimate the cost of system level activities such as integration and documentation.

3. ESTIMATION TECHNIQUES:[5]

Various techniques are used in software project management tools to cater the estimation procedure

i. Parametric Approach

ii. Heuristic Approach

All of the heuristic techniques are “soft” in that no model based estimation is used. There are many techniques that come under parametric as well as heuristic approaches. Few are elaborated.

i. Parametric Approaches:

LOC. Direct software size can be measured in terms of LOC (Lines of code), one of the oldest techniques. This measure was first proposed when programs were typed on cards with one line per card. Its disadvantage is that accuracy of LOC is highly dependent on the software completion and before that only expert judgment estimates.

Function Points Metrics. In FPA an estimated count is taken against Number of external inputs, outputs, Number of external inquiries, interface files, Number of internal logical files. For each domain value a low, medium or high weight is chosen. Besides the above mentioned domain values, fourteen complexity factors like Back up and recovery, Data Communication etc are given certain values as per software requirement and final estimate is calculated. Function points are simple to understand, easy to count, require little effort and practice. It is independent of the technology, methodology used. Function Point is mostly used than LOC and at times more accurate than LOC, however it is abstract, difficult to automate and not a direct software size measure rather related to the functionality of a system. FP is very subjective. They depend on the estimator. FPA does not assign due importance to processing complexity. None of the FP or LOC is an ideal metric for all types of projects. FP is suitable for MIS applications.

COCOMO and COCOMO-II: Constructive Cost Model (COCOMO) was first proposed by Barry W. Boehm. An empirical well-documented, independent model not tied to a specific software vendor, based on project experience is quite popular for software cost and effort estimation. The most fundamental calculation in the COCOMO model is the use of Effort Equation to estimate the number of Person-Months required to develop a project.

$$\text{Effort} = A \times (\text{SIZE})^B$$

Where A is proportionality constant and B represents economy. B depends on the development mode. The estimate of a project's size is in SLOC.

To get the respective results COCOMO takes LOC. COCOMO- II takes LOC, Function or Use Case points as software size input. COCOMO model is provided for three operational modes:

1. **Organic.** Applied in projects that have a small, experienced development team developing applications in a familiar environment.
2. **Semi-detached.** Semi-detached mode is for projects somewhere in between.
3. **Embedded.** Embedded mode should be applied to large projects, especially when the project is unfamiliar or there are severe time constraints

ii. Heuristic Approach

Expert Judgment Method. Expert judgment is done based on experience either just by a project manager or by a team of experts involved in the project. Process iterates until some consensus is reached. It works well in situations where no historical data is available. For estimation accuracy industry data can be used as a reference. Very small growing organization often makes use of this technique, however irrespective of the size or maturity of a software house, expert judgment is the widely used method in the industry. Several variations are adopted under expert estimation like it can be done in a group of experts of different domains belonging to the same or different projects.

Thumbs Rule. Thumbs rule is subjective in nature. Decision is taken based on personal interests, a biggest disadvantage of this method.

Delphi Technique. In Delphi technique a coordinator plays a central role. In this technique no direct interaction is there among the experts. Coordinator takes input from all the experts individually, compiles the result and continues the process until same and balanced feedback is captured.

Wide Band Delphi Technique. Wide band Delphi Technique was introduced at Rand Corporation. Later refined by Barry Boehm. The technique can help you estimate, plan and schedule almost anything. In wide band Delphi method a one to one interaction is there among the group members (experts) as opposite to Delphi technique. Here the conflicts if any are resolved face to face till a mutual agreed decision point is reached. Lots of overhead involves (time, team involvement, planning) for relatively small sets of tasks. However its strength lies in iterative, team based and collaborative meeting.

It is comprised of 6 steps:

1. Planning
2. Kickoff meeting
3. Individual preparation
4. Estimation meeting
5. Assembling tasks
6. Reviewing results & iteration

4. COMPARATIVE STUDY OF SOFTWARE PROJECT MANAGEMENT TOOL:

An overview of some of the tools studied in this paper. The tools studied are CoStar 7.0 developed by SoftStar Systems, Construx Estimate 2.0 developed by Construx Software Builders, COCOMO II. 1999.0 developed by University of Southern California, SLIM-ESTIMATE suite developed by Quality Software Management and Open Proj tool developed by Serena Software.

CoStar:[2]

CoStar is a software estimation tool based on COCOMO II. The tool is useful for generating estimates for size, effort, time duration and staffing level. This tool can generate reports for all the phases of development lifecycle, for the cost drivers, reports for schedule etc.

CoStar 7.0 runs under Windows 95, Windows 98, Windows NT 4, Windows 2000, and Windows XP. *CoStar* is a complete estimation tool and does not have any feature for management. It comes with its own calibrator called *Calico* which uses multiple regression method for calibration or the USC calibration tool can be used for its calibration.

The report generated by the tool includes estimated information only like the estimated size of a component, estimated time required in each phase, schedule estimates etc. CoStar is a perfect example of isolation of estimation process and management process in currently available tools. For calibration, CoStar does not store any past project data. Past projects' data needs to be fed in its calibrator i. e. *Calico*. Regression method needs a larger number of past projects' data for getting an accurate estimate, feeding which manually is a tiresome task. CoStar does not provide any facility for any kind of project tracking.

Construx Estimate:[1]

Construx Estimate is also a software estimation tool based on COCOMO II. The tool provides the user with 10 project types and subtypes, according to which the tool decides which COCOMO model should be used for estimation. Some of the project types are business system, control system, internet systems, real time systems(embedded and avionics) etc. It also has 10 phases of development for calculating the estimates accurately according to the phase. It also provides feature for adjusting the priority for schedule and effort. The outputs (estimates) are displayed in both the graphical form and in the text format.

Similar to CoStar, Construx Estimate is also a pure estimation tool without any feature for project management. Project tracking is also missing in the tool. Report is generated for the projects but with the estimates only not with the current status of the projects.

5. COCOMO II 1999.0:[4]

This is a tool developed in University of Southern California comprises of estimation and calibration. It provides user with the facility to estimate size using three methods; function point analysis, source lines of code or adaptation source lines of code. It also provides the feature for estimating for the maintenance phase. The best feature of the tool is its flexibility

that a user can even change the parameters' values used in the equation directly.

The tool does not have any management or tracking facilities but in calibration it can import data from any source file or the data stored in the tool of the earlier project (in this case still actual size and effort needs manual entry). The calibration method used in the tool is again multiple regression method which has its own drawbacks. The tool does not generate any kind of report.

6. SLIM-ESTIMATE:[3]

SLIM-ESTIMATE is a tool developed by Quality Software Management and used for estimation. This tool is available with its aide for planning, tracking and calibration.

QSM is a tool based on SLIM estimation model. It has its own calibration and control module. It provides user with five solution options; detailed input method, quick estimate, solve for productivity index, solve for size and create solution from history. If little information about the project is available then quick estimate is used otherwise detailed input method can be used for a detailed estimate. If user has the schedule, effort and is given the size then user can use solve for productivity index method which gives the required productivity index for the project's development within the given schedule and with the given effort and size. If the project's size is only the missing information then solve for size method can be used to get the size estimate that can be built with the given effort, productivity index and within the given schedule. Report generation is the only feature missing in the tool.

Open Proj

- Developer: Serena Software
- OpenProj is an open source project management software intended as a complete desktop replacement for Microsoft Project, being able to open existing native Project files
- It was developed by Projity in 2007.
- OpenProj runs on the Java Platform, allowing it to run on a variety of different operating systems.

The current version includes

- Earned Value costing
- Gantt chart
- PERT graph
- Resource Breakdown Structure (RBS) chart
- Task usage reports
- Work Breakdown Structure(WBS) chart

OpenProj provides control, tracking and management of projects. OpenProj works on Linux, Unix, Mac or Windows platforms, and it's free.

Study of tools has revealed the following drawbacks in the current scenario.

Drawbacks

1. Tools available for the above activities are isolated to each other i. e. the tools available are either estimation tools or for planning and tracking.
2. The tools available for planning used to send the information of task assigned to individuals through mails and the information pertinent to the assigned task is kept in some version control system.
3. Any supporting documents or reports should be available to the person in the organization like SRS for the project, design specification. Current tools do not have this feature.
4. During the development, the management needs to keep track of information about the status of project; the tools available do not have such features.
5. Reports at any stage of development are needed another important feature absent in available tools.
6. While calibration, past projects' data need to be fetched manually.
7. The method used for calibration of tools does not incorporate the expert's judgment in the resulting parameter values.

The Proposed Solution Overview

The major problem in the current scenario is the isolated estimation, planning & tracking and calibration, so the solution would be *Project Management Software* that will combine these activities. The proposed system will first store the details of the projects, clients and developers which are right now in paper form or if available in electronic form are in isolation to each other. The information about the projects, clients, developers would be available easily. The system will automate the process of the estimation using the COCOMO II model for effort estimation. The system will also help in tracking the status of project by taking daily input from each developer in the organization and will show the status in the form of a Gantt chart. The system will generate the reports for the projects. While calibrating the model the system will incorporate the experts' judgment in the final values of parameters of the model. The system will give the information about the activities in the organization and the time taken in each activity.

Benefits of Proposed Solution

1. Clumsy calculation for estimation is no longer needed.
2. Planning and tracking would rather be a simpler task.
3. Information about the projects, clients and developers are no longer needed to be stored in other forms.
4. Activity details would be available easily.
5. The reports could be generated with a single mouse click.
6. Notification on various conditions can be customized according to the users' choice.

7. Data for calibration would be available in the tool itself and no manual data entry is required for calibration.
8. The calibration would be more accurate and hence the estimation too.

7. CONCLUSION

Software estimation helps project management to plan the project. Tools available for the project estimation are great helps in the process. But estimating the project and then planning it without caring about the status of project at any instant of time is a problem worth to be considered. The process known as tracking is an important process that needs to be integrated with the estimation and planning process. The core of software crisis starts with the wrong estimation. Thus the calibration of the model being used for the estimation, with the past projects' data experienced by the organization, is an activity of utmost importance. The calibration of the estimation model against organization, team and project should be done regularly. Various papers of Software project management studied for estimation, planning, tracking and calibration. Which are helpful for software project management tool analysis.

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